Definition of filtration performance – from EN 779 to ISO 16890

SYLVAIN COURTEY
Head of Ventilation Department
Eurovent Certita Certification

A new ISO standard is about to replace the current EN 779 standard used to characterize the filtration efficiency of filters now classified from G1 to F9. This new standard incorporates a different approach from the current standard in terms of classification methodology and will therefore have a significant impact on the market. It is proposed here to present the main changes, to detail the future benefits provided by this standard and to consider the impact on the certification of the filters.

New ISO 16890 - A new way to classify filters

Over the past five years, a new approach has been developed within the ISO standardization working groups to characterize filter filtration efficiency. This new approach is to look at filtration efficiency not only for particles with a diameter of 0.4 µm but to consider the entire spectrum of particle sizes.

The EN779:2012 standard used today in Europe to characterize the filtration efficiency of the filters for the ventilation of buildings defines the filtration classes according to the average filtration efficiency of the particles with a diameter of 0.4 µm (see **Table 1** below).

Table 1. Filter classification according to EN 779:2012.

Group	Class	Average efficiency (Em) at 0,4 µm	Minimum efficiency at 0,4 µm
Medium	M5	40≤ E_m<60	–
	M6	60≤ Em<80	–
Fine	F7	80≤ Em<90	35
	F8	90≤ Em<95	55
	F9	95≤ Em	70

The convention of using only the filtration efficiency of particles with a diameter of 0.4 µm is due to the fact that particles of this size are the most difficult to filter. Indeed, for particles with a smaller diameter, the phenomenon of diffusion predominates, whereas for particles with a larger diameter, the phenomenon of interception is predominant (see **Figure 1** below).

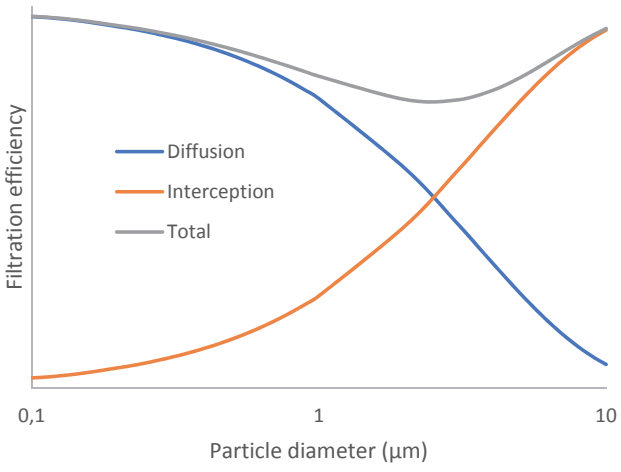

Figure 1. Particle filtration efficiency according to size.

For most media filtering the minimum efficiency is around 0.4 µm.

The current system therefore makes it possible to compare filters between them, but it is not easy to evaluate the effectiveness of a filter with regards to its impact on air quality.

From this observation, it has been suggested to characterize the filters in relation to indicators that have been used for several years in the field of air quality: particulate matter (PM): PM_{10}, $PM_{2.5}$ and PM_1 which respectively define the air concentrations in liquid or solid particles whose diameter is below 10, 2.5 and 1 µm.

These indicators are used in many health and toxicological studies. They make it possible to classify the particles according to their dangerousness:

- Particles with a diameter greater than 10 µm are retained by the upper airway and are not breathed.
- Particles with a diameter of less than 10 µm (PM_{10}) can penetrate the bronchi.
- Particles with a diameter below 2.5 µm ($PM_{2.5}$) can penetrate the pulmonary alveoli.
- Particles with a diameter below 1 µm (PM_1) can penetrate the alveolo-capillary barrier.

The new standard therefore classifies filters relative to their filtration efficiency for these different particle sizes according to **Table 2**.

With respect to PM_1 the efficiency of a filter classified as ePM_1[80%] will be above 80% and below 85%.

a. Other changes from EN 779:2012.

The new ISO 16890 standard will be divided into four parts covering all the chapters currently covered by EN 779:2012 according to **Table 3**.

Table 2. Filter classification according to ISO 16890-1.

Group	Initial efficiency in PM_x	Discharged efficiency PM_x
ePM_{10}	≥ 50% (PM_{10})	≥ 50% (PM_{10})
$ePM_{2.5}$	≥ 50% ($PM_{2.5}$)	≥ 50% ($PM_{2.5}$)
ePM_1	≥ 50% (PM_1)	≥ 50% (PM_1)

Table 3. Filter classification according to ISO 16890-1.

Object	ISO 16890	EN 779:2012
Technical specifications, requirements and classification	Part 1	Chapters 5 - 6
Efficiency measurements	Part 2	Chapters 7, 8 and 9
Definition of the gravimetric efficiency	Part 3	Chapter 10.4
Packaging method to determine the minimum spectral efficiency of the test	Part 4	Chapter 11

Beyond the new approach of classification of the filters certain evolutions are to be noted:

- requirements have been introduced with respect to the test conditions in terms of temperature and relative humidity.
- the conditioning method for determining the minimum efficiency makes it possible to test a complete filter and not only the filter media as with the EN 779:2012.
- "Fine AC" dust is used to determine gravimetric efficiency as a replacement for standardized dust such as "ASHRAE".

Publication of ISO 16890

The four parts of ISO 16890* have been published in December 2016. It is expected that it will last 18 months before EN 779: 2012 will be withdrawn, this to allow the manufacturers to adapt their current catalogues.

1. Benefits for the end user

a. Towards a universal method?

The adoption of this new standard may perhaps make it possible to harmonize worldwide the method of characterizing the efficiency of filters. Today two systems predominate:

- In Europe, the method EN 779:2012 is the only one
- In North America, the ASHRAE 52.2 method is used exclusively
- In Asia the European and American systems coexist.

* At CEN level in Europe this ISO standard is indicated as EN-ISO 16890 and when published on national level the letters of the National Standard Body are added, like e.g. DIN-EN-ISO 16890

In the future, the new ISO standard is intended to be the universally used method. However, there is no indication that this will be the case, a standard being of a voluntary nature. However, we can say that this standard will be the future reference in Europe as it has already been decided that it will replace the current EN779: 2012. Similarly in Asia there is a good chance that they will become the benchmark except in the markets where US players are predominant.

However, in North America doubts remain about the possible use of this ISO standard. Indeed, the ASHRAE methods have been established for a long time and the United States has shown some reluctance throughout the validation process of this ISO standard.

A clearer link between filter efficiency and indoor air quality

As indicated earlier, concentrations of PM_{10} and to a lesser extent $PM_{2.5}$ and PM_1 are now widely used for assessing air quality. The European "Airbase" project gathers data from more than 8 000 continuous PM_{10} measurement stations in Europe (see **Figure 2** below). WHO defines guidelines for maximum levels of concentrations not to be exceeded for PM_{10} and $PM_{2.5}$.

The use of efficiency referring to these indicators will enable end-users to more easily assess their needs based on outdoor air quality and their objectives in terms of indoor air quality.

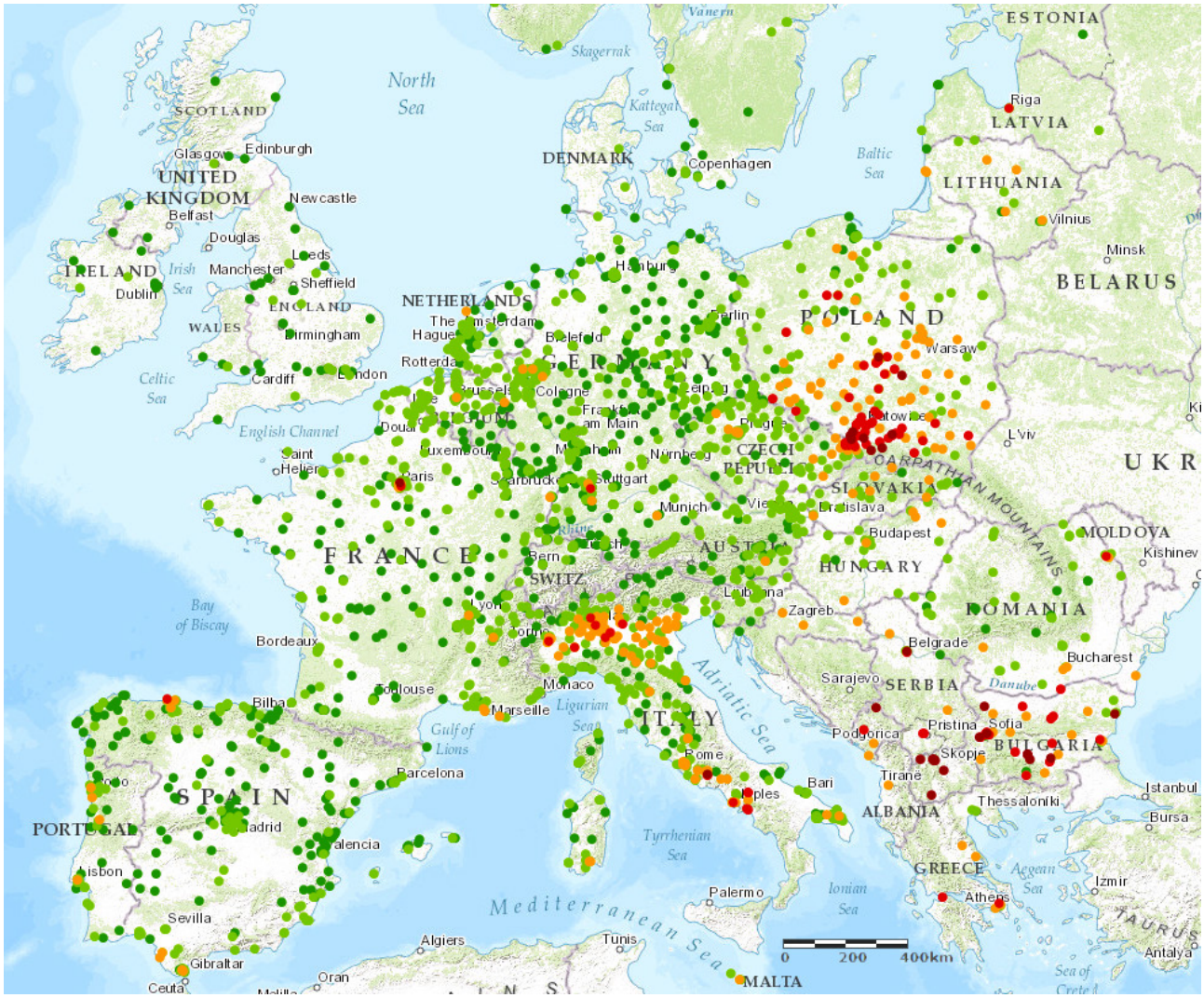

Figure 2. Location of continuous PM_{10} measurements in Europe (Source: Airbase).

2. **What impact on the certification of filters for ventilation?**
   a. The Eurovent certification for filters:
      i. The certification programme « Eurovent Certified Performance » for Air Filters M5 – F9 was launched in 2006. This certification is based on tests carried out by independent ISO 17025 laboratories, according to EN 779:2012 (which replaced EN 779:2002). This programme covers the certification of all relevant performances of filters used for general ventilation, namely:

- The filtration class
- The initial pressure drop
- The initial efficiency
- The minimum efficiency

These performances related to the Standard EN 779:2012 add up to the performances related to the energy efficiency as defined in the Standard Eurovent 4/21.

- Annual energy consumption
- Energy efficiency class

All certified data are available on www.eurovent-certification.com.

      ii. In 2016 this certification programme covers 25 manufacturers representing 25 brands and more than 2300 references. According to the latest figures from Eurovent Market Intelligence, this programme covers 87% of the French market and 75% of the European market.

Evolution and next steps

The first four parts of the new ISO 16890 standard cover all the chapters covered today by the European standard EN 779. Thus it does not define a method for calculating the average annual energy consumption as defined in document Eurovent 4 / 21. A revision of the latter must therefore be carried out in order to integrate the new provisions of ISO 16890. A Eurovent working group dedicated to this project was recently set up, and met for the first time in December 2015. A first revision project is planned for February 2016.

The Eurovent certification of filters will then be able to evolve towards the new standard once it has replaced the standard EN 779.

Conclusion

The new ISO 16890 Standard will have a significant impact on all the actors of filtration. In the first place manufacturers will have to characterize all their products according to this new method. Knowing that standardized dust will also change this implies a significant effort on their part, the old standardized dust being used for decades.

Secondly, buyers will have to completely revise their current requirements based on the well-known filtration classes M5, M6, F7, F8 and F9. It is expected that a transition period will be required (with dual labeling of products) before the new efficiency classes are integrated by buyers. A major effort will have to be made by all the players (notably the manufacturers) to communicate effectively on these changes. The fact that the vast majority of products available on the market are certified will facilitate this transition by providing clear and controlled information. ■

References

ISO 16890-1, Air filters for general ventilation – Part 1: Technical specifications, requirements and classification system based upon particular matter efficiency (ePM).

ISO 16890-2, Air filters for general ventilation – Part 2: Measurement of fractional efficiency and air flow resistance.

ISO 16890-3, Air filters for general ventilation – Part 3: Determination of the gravimetric efficiency and the air flow resistance versus the mass of test dust captured

ISO 16890-4, Air filters for general ventilation – Part 4: Conditioning method to determine the minimum fractional test efficiency

EN 779:2012, Particulate air filters for general ventilation – Determination of the filtration performance.

Eurovent 4/21 – 2014: Calculation method for the energy use related to air filters in general ventilation systems

ANSI/ASHRAE 52.2 – 2007, Method of testing general ventilation air-cleaning devices for removal efficiency by particle size

Airbase – The European Air Quality Database, http://www.eea.europa.eu/data-and-maps/data/airbase-the-european-air-quality-database-8

OMS guidelines for air quality: particulate matter, ozone, nitrogen dioxide and sulphur dioxide, Global update 2005. http://www.euro.who.int/__data/assets/pdf_file/0005/78638/E90038.pdf